CHAPTER 11

Managing User Accounts

IN THIS CHAPTER

Working with user accounts

Working with group accounts

Configuring centralized user accounts

Adding and managing users are common tasks for Linux system administrators. *User accounts* keep boundaries between the people who use your systems and between the processes that run on your systems. *Groups* are a way of assigning rights to your system that can be assigned to multiple users at once.

This chapter describes not only how to create a new user, but also how to create predefined settings and files to configure the user's environment. Using tools such as the `useradd` and `usermod` commands, you can assign settings such as the location of a home directory, a default shell, a default group, and specific user ID and group ID values. With Cockpit, you can add and manage user accounts through a web UI.

Creating User Accounts

Every person who uses your Linux system should have a separate user account. Having a user account provides you with an area in which to store files securely as well as a means of tailoring your user interface (GUI, path, environment variables, and so on) to suit the way that you use the computer.

You can add user accounts to most Linux systems in several ways. Fedora and Red Hat Enterprise Linux systems offer *Cockpit*, which includes an Account selection for creating and managing user accounts. If Cockpit is not yet installed and enabled, do that as follows:

```
# yum install cockpit -y
# systemctl enable --now cockpit.socket
```


Linux® Bible, Tenth Edition. Christopher Negus.

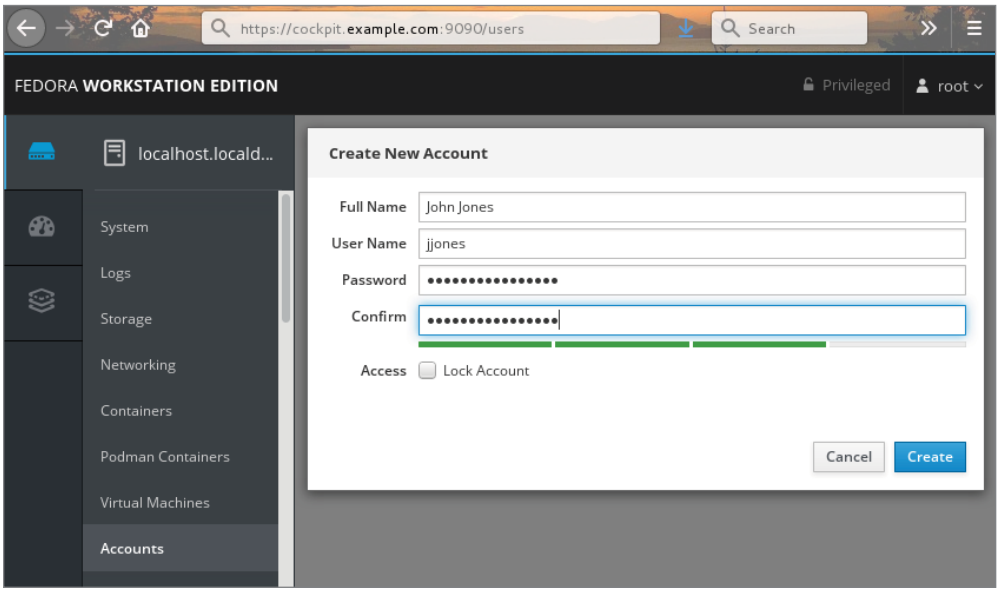
To create a user account through Cockpit, do the following:

1. Open the Cockpit interface from your web browser (`hostname:9090`).
2. Log in as root (or as a user with root privilege), select the "Reuse my password for privileged tasks" check box, and select Accounts.
3. Select Create New Account.

   Figure 11.1 shows an example of the Create New Account pop-up window:

FIGURE 11.1

Add and modify user accounts from Cockpit.



4. Begin adding a new user account to your Linux system. Here are the fields you need to fill in:

   Full Name Use the user's real name, typically used with uppercase and lowercase letters, as the user would write it in real life. Technically, this information is stored in the comment field of the `passwd` file, but by convention, most Linux and UNIX systems expect this field to hold each user's full name.

   User Name This is the name used to log in as this user. When you choose a username, don't begin with a number (for example, 26jsmith). Also, it's best to use all lowercase letters, no control characters or spaces, and a maximum of eight characters, by convention. The `useradd` command allows up to 32 characters,

but some applications can't deal with usernames that long. Tools such as `ps` display user IDs (UIDs) instead of names if names are too long. Having users named Jsmith and jsmith can cause confusion with programs (such as sendmail) that don't distinguish case.

Password, Confirm Enter the password you want the user to have in the Password and Confirm fields. The password should be at least eight characters long and contain a mixture of uppercase and lowercase letters, numbers, and punctuation. It should not contain real words, repeated letters, or letters in a row on the keyboard. Through this interface, you must set a password that meets the above criteria. (If you want to add a password that doesn't meet this criteria, you can use the `useradd` command, described later in this chapter.)Bars underneath the password fields turn from red to green as you improve the strength of your password.

Access To create an account that you are not quite ready to use, select the Lock Account check box. That prevents anyone from logging into the account until you uncheck that box or change that information in the `passwd` file.

5. Select Create to add the user to the system. An entry for the new user account is added to the `/etc/passwd` file and the new group account to the `/etc/group` file. (I will describe those later in this chapter.)

The Cockpit Accounts screen lets you modify a small set of information about a regular user after it has been created. To modify user information later, do the following:

1. Select the user account that you want to change. A screen appears with available selections for that user account.
2. You can delete but not modify the username, but you can change the following: information:

Full Name Because the user's full name is just a comment, you can change that as you please.

Roles By default, you have the opportunity to select check boxes that allow the user to be added to the role of Server Administrator (giving the user root privilege by being added to the wheel group) or Image Builder (allowing the user to build containers and other image types through the weldr group). Other roles might be added to this list by other Cockpit components. If the user is logged in, that user must log out to obtain those privileges.

Access You can choose Lock Account to lock the account, select to lock the account on a particular date, or never lock the account (setting no account expiration date).

Password You can choose Set Password to set a new password for that user or Force Change to force the user to change their password the next time they log in. By default, passwords never expire. You can change that to have the password expire every set number of days.

Authorized Public SSH Keys If you have a public SSH key for the user, you can select the plus sign (+) for this field, paste that key into the text box, and select Add key. With that key in place, the user with the associated private key is allowed to log into that user account via SSH without needing to enter a password.

3. Changes take effect immediately, so you can simply leave the window when you are done modifying the user account.

The Accounts area of the Cockpit web UI was designed to simplify the process of creating and modifying user accounts. More features associated with user accounts can be added or modified from the command line. The next part of this chapter describes how to add user accounts from the command line with `useradd` and change them with the `usermod` command.

Adding users with useradd

Sometimes, a Linux system doesn't have a desktop tool or web UI available for adding users. Other times, you might find it more convenient to add lots of users at once with a shell script or change user account features that are not available from Cockpit. For those cases, commands are available to enable you to add and modify user accounts from the command line.

The most straightforward method for creating a new user from the shell is the `useradd` command. After opening a Terminal window with root permission, you simply invoke `useradd` at the command prompt, with details of the new account as parameters.

The only required parameter is the login name of the user, but you probably want to include some additional information ahead of it. Each item of account information is preceded by a single-letter option code with a dash in front of it. The following options are available with `useradd`:

- **`-c "`*`comment`*`"`**: Provide a description of the new user account. Typically, this is the person's full name. Replace *`comment`* with the name of the user account (`-c Jake`). Use quotes to enter multiple words (for example,`-c "Jake Jackson"`).
- **`-d`** ***`home_dir`***: Set the home directory to use for the account. The default is to name it the same as the login name and to place it in `/home`. Replace *`home_dir`* with the directory name to use (for example, `-d /mnt/homes/jake`).
- **`-D`**: Rather than create a new account, save the supplied information as the new default settings for any new accounts that are created.
- **`-e`** ***`expire_date`***: Assign the expiration date for the account in *YYYY-MM-DD* format. Replace *`expire_date`* with a date that you want to use. (For example, to expire an account on May 5, 2022, use `-e 2022-05-05`.)
- **`-f -1`**: Set the number of days after a password expires until the account is permanently disabled. The default, `-1`, disables the option. Setting this to `0` disables the

account immediately after the password has expired. Replace `-1` (that's minus one) with the number to use.

-g *group*: Set the primary group (it must already exist in the `/etc/group` file) the new user will be in. Replace *group* with the group name (for example, `-g wheel`). Without this option, a new group is created that is the same as the username and is used as that user's primary group.

-G *grouplist*: Add the new user to the supplied comma-separated list of supplementary groups (for example, `-G wheel,sales,tech,lunch`). (If you use `-G` later with `usermod`, be sure to use `-aG` and not just `-G`. If you don't, existing supplementary groups are removed and the groups you provide here are the only ones assigned.)

-k *skel_dir*: Set the skeleton directory containing initial configuration files and login scripts that should be copied to a new user's home directory. This parameter can be used only in conjunction with the `-m` option. Replace *skel_dir* with the directory name to use. (Without this option, the `/etc/skel` directory is used.)

-m: Automatically create the user's home directory and copy the files in the skeleton directory (`/etc/skel`) to it. (This is the default action for Fedora and RHEL, so it's not required. It is not the default for Ubuntu.)

-M: Do not create the new user's home directory, even if the default behavior is set to create it.

-n: Turn off the default behavior of creating a new group that matches the name and user ID of the new user. This option is available with Fedora and RHEL systems. Other Linux systems often assign a new user to the group named `users` instead.

-o: Use with `-u uid` to create a user account that has the same UID as another username. (This effectively lets you have two different usernames with authority over the same set of files and directories.)

-p *passwd*: Enter a password for the account you are adding. This must be an encrypted password. Instead of adding an encrypted password here, you can simply use the `passwd` *user* command later to add a password for *user*. (To generate an encrypted MD5 password, type `openssl passwd`.)

-s *shell*: Specify the command shell to use for this account. Replace *shell* with the command shell (for example, `-s /bin/csh`).

-u *user_id*: Specify the user ID number for the account (for example, `-u 1793`). Without the `-u` option, the default behavior is to assign the next available number automatically. Replace `user_id` with the ID number. User IDs that are automatically assigned to regular users begin at 1000, so you should use IDs for regular users that are above that number in a way that doesn't collide with the automatic assignments.

Let's create an account for a new user. The user's full name is Sara Green, with a login name of sara. To begin, become root user and type the following command:

```
# useradd -c "Sara Green" sara
```

Next, set the initial password for sara using the passwd command. You're prompted to type the password twice:

```
# passwd sara
Changing password for user sara.
New password: **********
Retype new password: **********
```

NOTE

Asterisks in this example represent the password you type. Nothing is actually displayed when you type the password. Also, keep in mind that running passwd as root user lets you add short or blank passwords that regular users cannot add themselves.

In creating the account for sara, the useradd command performs several actions:

- Reads the /etc/login.defs and /etc/default/useradd files to get default values to use when creating accounts.
- Checks command-line parameters to find out which default values to override.
- Creates a new user entry in the /etc/passwd and /etc/shadow files based on the default values and command-line parameters.
- Creates any new group entries in the /etc/group file. (Fedora creates a group using the new user's name.)
- Creates a home directory based on the user's name in the /home directory.
- Copies any files located within the /etc/skel directory to the new home directory. This usually includes login and application startup scripts.

The preceding example uses only a few of the available useradd options. Most account settings are assigned using default values. You can set more values explicitly if you want to. Here's an example that uses a few more options to do so:

```
# useradd -g users -G wheel,apache -s /bin/tcsh -c "Sara Green" sara
```

In this case, useradd is told to make users the primary group sara belongs to (-g), add her to the wheel and apache groups, and assign tcsh as her primary command shell (-s). A home directory in /home under the user's name (/home/sara) is created by default. This command line results in a line similar to the following being added to the /etc/passwd file:

```
sara:x:1002:1007:Sara Green:/home/sara:/bin/tcsh
```

Each line in the /etc/passwd file represents a single user account record. Each field is separated from the next by a colon (:) character. The field's position in the sequence determines what it is. As you can see, the login name is first. The password field contains an x because, in this example, the shadow password file is used to store encrypted password data (in /etc/shadow).

The user ID selected by useradd is 1002. The primary group ID is 1007, which corresponds to a private sara group in the /etc/group file. The comment field was correctly set to Sara Green, the home directory was automatically assigned as /home/sara, and the command shell was assigned as /bin/tcsh, exactly as specified with the useradd options.

By leaving out many of the options (as I did in the first useradd example), defaults are assigned in most cases. For example, by not using -g sales or -G wheel,apache, the group name sara was assigned to the new user. Some Linux systems (other than Fedora and RHEL) assign users as the group name by default. Likewise, excluding -s /bin/tcsh causes /bin/bash to be assigned as the default shell.

The /etc/group file holds information about the different groups on your Linux system and the users who belong to them. Groups are useful for enabling multiple users to share access to the same files while denying access to others. Here is the /etc/group entry created for sara:

```
sara:x:1007:
```

Each line in the group file contains the name of a group, a group password (usually filled with an x), the group ID number associated with it, and a list of users in that group. By default, each user is added to their own group, beginning with the next available GID, starting with 1000.

Setting user defaults

The useradd command determines the default values for new accounts by reading the /etc/login.defs and /etc/default/useradd files. You can modify those defaults by editing the files manually with a standard text editor. Although login.defs is different on different Linux systems, the following is an example containing many of the settings that you might find in a login.defs file:

```
PASS_MAX_DAYS     99999
PASS_MIN_DAYS     0
PASS_MIN_LEN      5
PASS_WARN_AGE     7
UID_MIN                  1000
UID_MAX                 60000
SYS_UID_MIN               200
SYS_UID_MAX               999
GID_MIN                  1000
```

```
GID_MAX                 60000
SYS_GID_MIN               201
SYS_GID_MAX               999
CREATE_HOME yes
```

All uncommented lines contain keyword/value pairs. For example, the keyword `PASS_MIN_LEN` is followed by some white space and the value `5`. This tells `useradd` that the user password must be at least five characters. Other lines enable you to customize the valid range of automatically assigned user ID numbers or group ID numbers. (Fedora starts at UID 1000; earlier systems started with UID 100.) Permanent administrative user and group account numbers are reserved for up to 199 and 200, respectively. So, you can assign your own administrative user and group accounts starting at 200 and 201, respectively, up to ID number 999.

A comment section that explains the keyword's purpose precedes each keyword (which I edited out here to save space). Altering a default value is as simple as editing the value associated with a keyword and saving the file before running the `useradd` command.

If you want to view other default settings, find them in the `/etc/default/useradd` file. You can also see default settings by typing the `useradd` command with the `-D` option, as follows:

```
# useradd -D
GROUP=100
HOME=/home
INACTIVE=-1
EXPIRE=
SHELL=/bin/bash
SKEL=/etc/skel
CREATE_MAIL_SPOOL=yes
```

You can also use the `-D` option to change defaults. When run with this flag, `useradd` refrains from actually creating a new user account; instead, it saves any additionally supplied options as the new default values in `/etc/default/useradd`. Not all `useradd` options can be used in conjunction with the `-D` option. You can use only the five options listed here.

- **`-b` *`default_home`***: Set the default directory in which user home directories are created. Replace *`default_home`* with the directory name to use (for example, `-b /garage`). Usually, this is `/home`.
- **`-e` *`default_expire_date`***: Set the default expiration date on which the user account is disabled. The *`default_expire_date`* value should be replaced with a date in the form YYYY-MM-DD (for example, `-e 2011-10-17`).
- **`-f` *`default_inactive`***: Set the number of days after a password has expired before the account is disabled. Replace *`default_inactive`* with a number representing the number of days (for example, `-f 7`).

- **-g *default_group***: Set the default group in which new users will be placed. Normally, `useradd` creates a new group with the same name and ID number as the user. Replace *default_group* with the group name to use (for example, `-g bears`).
- **-s *default_shell***: Set the default shell for new users. This is `/bin/bash`, typically. Replace *default_shell* with the full path to the shell that you want as the default for new users (for example, `-s /bin/ash`).

To set any of the defaults, give the `-D` option first and add the defaults that you want to set. For example, to set the default home directory location to `/home/everyone` and the default shell to `/bin/tcsh`, enter the following:

```
# useradd -D -b /home/everyone -s /bin/tcsh
```

In addition to setting up user defaults, an administrator can create default files that are copied to each user's home directory for use. These files can include login scripts and shell configuration files (such as `.bashrc`). Keep in mind that setting up these kinds of files is the purpose of the default `/etc/skel` directory.

Other commands that are useful for working with user accounts include `usermod` (to modify settings for an existing account) and `userdel` (to delete an existing user account).

Modifying users with usermod

The `usermod` command provides a simple and straightforward method for changing account parameters. Many of the options available with it mirror those found in `useradd`. The options that can be used with this command include the following:

- **-c *username***: Change the description associated with the user account. Replace *username* with the name of the user account (`-c jake`). Use quotes to enter multiple words (for example, `-c "Jake Jackson"`).
- **-d *home_dir***: Change the home directory to use for the account. The default is to name it the same as the login name and to place it in `/home`. Replace *home_dir* with the directory name to use (for example, `-d /mnt/homes/jake`).
- **-e *expire_date***: Assign a new expiration date for the account in *YYYY-MM-DD* format. Replace *expire_date* with a date you want to use. (For October 15, 2022, use `-e 2022-10-15`.)
- **-f -1**: Change the number of days after a password expires until the account is permanently disabled. The default, `-1`, disables the option. Setting this to `0` disables the account immediately after the password has expired. Replace `-1` with the number to use.
- **-g *group***: Change the primary group (as listed in the `/etc/group` file) the user will be in. Replace *group* with the group name (for example, `-g wheel`).

- **-G *grouplist***: Set the user's secondary groups to the supplied comma-separated list of groups. If the user is already in at least one group besides the user's private group, you must add the `-a` option as well (`-Ga`). If not, the user belongs to only the new set of groups and loses membership to any previous groups.
- **-l *login_name***: Change the login name of the account.
- **-L**: Lock the account by putting an exclamation point at the beginning of the encrypted password in `/etc/shadow`. This locks the account while still allowing you to leave the password intact (the `-U` option unlocks it).
- **-m**: Available only when `–d` is used. This causes the contents of the user's home directory to be copied to the new directory.
- **-o**: Use only with `-u uid` to remove the restriction that UIDs must be unique.
- **-s *shell***: Specify a different command shell to use for this account. Replace *shell* with the command shell (for example, `-s bash`).
- **-u *user_id***: Change the user ID number for the account. Replace *user_id* with the ID number (for example, `-u 1474`).
- **-U**: Unlocks the user account (by removing the exclamation mark at the beginning of the encrypted password).

The following are examples of the `usermod` command:

```
# usermod -s /bin/csh chris
# usermod -Ga sales,marketing, chris
```

The first example changes the shell to the `csh` shell for the user named `chris`. In the second example, supplementary groups are added for the user `chris`. The `-a` option (`-Ga`) makes sure that the supplementary groups are added to any existing groups for the user `chris`. If the `-a` is not used, existing supplementary groups for `chris` are erased and the new list of groups includes the only supplementary groups assigned to that user.

Deleting users with userdel

Just as `usermod` is used to modify user settings and `useradd` is used to create users, `userdel` is used to remove users. The following command removes the user `chris`:

```
# userdel -r chris
```

Here, the user `chris` is removed from the `/etc/password` file. The `–r` option removes the user's home directory as well. If you choose not to use `–r`, as follows, the home directory for `chris` is not removed:

```
# userdel chris
```

Keep in mind that simply removing the user account does not change anything about the files that user leaves around the system (except those that are deleted when you use `-r`). However, ownership of files left behind appear as belonging to the previous owner's user ID number when you run `ls -l` on the files.

Before you delete the user, you may want to run a `find` command to find all files that would be left behind by the user. After you delete the user, you could search on user ID to find files left behind. Here are two `find` commands to do those things:

```
# find / -user chris -ls
# find / -uid 504 -ls
```

Because files that are not assigned to any username are considered to be a security risk, it is a good idea to find those files and assign them to a real user account. Here's an example of a `find` command that finds all files in the filesystem that are not associated with any user (the files are listed by UID):

```
# find / -nouser -ls
```

Understanding Group Accounts

Group accounts are useful if you want to share a set of files with multiple users. You can create a group and change the set of files to be associated with that group. The root user can assign users to that group so they can have access to files based on that group's permission. Consider the following file and directory:

```
$ ls -ld /var/salesdocs /var/salesdocs/file.txt
drwxrwxr-x. 2 root sales 4096 Jan 14 09:32 /var/salesstuff/
-rw-rw-r--. 1 root sales    0 Jan 14 09:32 /var/salesstuff/file.txt
```

Looking at permissions on the directory `/var/salesdocs` (`rwxrwxr-x`), you see the second set of `rwx` shows that any member of the group (`sales`) has permission to read files in that directory (`r` is read), create and delete files from that directory (`w` is write), and change to that directory (`x` is execute). The file named `file.txt` can be read and changed by members of the sales group (based on the second `rw-`).

Using group accounts

Every user is assigned to a primary group. In Fedora and RHEL, by default, that group is a new group with the same name as the user. So, if the user were named `sara`, the group assigned to her would also be `sara`. The primary group is indicated by the number in the third field of each entry in the `/etc/passwd` file; for example, the group ID 1007 here:

```
sara:x:1002:1007:Sara Green:/home/sara:/bin/tcsh
```

That entry points to an entry in the `/etc/group` file:

```
sara:x:1007:
```

Let's turn to the `sara` user and group accounts for examples. Here are a few facts about using groups:

- When `sara` creates a file or directory, by default, that file or directory is assigned to `sara`'s primary group (also called `sara`).

- The user sara can belong to zero or more supplementary groups. If sara were a member of groups named sales and marketing, those entries could look like the following in the /etc/group file:

```
sales:x:1302:joe,bill,sally,sara
marketing:x:1303:mike,terry,sara
```

- The user sara can't add herself to a supplementary group. She can't even add another user to her sara group. Only someone with root privilege can assign users to groups.
- Any file assigned to the sales or marketing group is accessible to sara with group and other permissions (whichever provides the most access). If sara wants to create a file with the sales or marketing groups assigned to it, she could use the newgrp command. In this example, sara uses the newgrp command to have sales become her primary group temporarily and creates a file:

```
[sara]$ touch file1
[sara]$ newgrp sales
[sara]$ touch file2
[sara]$ ls -l file*
-rw-rw-r--. 1 sara sara  0 Jan 18 22:22 file1
-rw-rw-r--. 1 sara sales 0 Jan 18 22:23 file2
[sara]$ exit
```

It is also possible to allow users to become a member of a group temporarily with the newgrp command without actually being a member of that group. To do that, someone with root permission can use gpasswd to set a group password (such as gpasswd sales). After that, any user can type newgrp sales into a shell and temporarily use sales as their primary group by simply entering the group password when prompted.

Creating group accounts

As the root user, you can create new groups from the command line with the groupadd command. Also, as noted earlier, groups are created automatically when a user account is created.

Group ID numbers from 0 through 999 are assigned to special administrative groups. For example, the root group is associated with GID 0. Regular groups begin at 1000 for Red Hat Enterprise Linux and Fedora. On the first UNIX systems, GIDs went from 0 to 99. Other Linux systems reserve GIDs between 0 to 500 for administrative groups. A relatively new feature, described earlier, reserves administrative user and group accounts up to 199 and 200, respectively, and lets you create your own administrative accounts between those numbers and 999.

Here are some examples of creating a group account with the `groupadd` command:

```
# groupadd kings
# groupadd -g 1325 jokers
```

In the examples just shown, the group named `kings` is created with the next available group ID. After that, the group `jokers` is created using the `1325` group ID. Some administrators like using an undefined group number above 200 and under 1000 so that the group they create doesn't intrude on the group designations above 1000 (so UID and GID numbers can go along in parallel).

To change a group later, use the `groupmod` command, as in the following example:

```
# groupmod -g 330 jokers
# groupmod -n jacks jokers
```

In the first example, the group ID for `jokers` is changed to 330. In the second, the name `jokers` is changed to `jacks`. If you then wanted to assign any of the groups as supplementary groups to a user, you can use the `usermod` command (as described earlier in this chapter).

Managing Users in the Enterprise

The basic Linux method of handling user and group accounts has not changed since the first UNIX systems were developed decades ago. However, as Linux systems have become used in more complex ways, features for managing users, groups, and the permissions associated with them have been added on to the basic user/group model so that it could be more flexible and more centralized:

More flexible In the basic model, only one user and one group can be assigned to each file. Also, regular users have no ability to assign specific permissions to different users or groups and very little flexibility setting up collaborative files/directories. Enhancements to this model allow regular users to set up special collaborative directories (using features such as sticky bit and set GID bit directories). Using Access Control Lists (ACLs), any user can also assign specific permissions to files and directories to any users and groups they like.

More centralized When you have only one computer, storing user information for all users in the `/etc/passwd` file is probably not a hardship. However, if you need to authenticate the same set of users across thousands of Linux systems, centralizing that information can save lots of time and heartache. Red Hat Enterprise Linux includes features that enable you to authenticate users from LDAP servers or Microsoft Active Directories servers.

The following sections describe how to use features such as Access Control Lists (ACLs) and shared directories (sticky bit and set GID bit directories) to provide powerful ways to share files and directories selectively.

Setting permissions with Access Control Lists

The *Access Control List (ACL)* feature was created so that regular users could share their files and directories selectively with other users and groups. With ACLs, a user can allow others to read, write, and execute files and directories without leaving those filesystem elements wide open or requiring the root user to change the user or group assigned to them.

Here are a few things to know about ACLs:

- For ACLs to be used, they must be enabled on a filesystem when that filesystem is mounted.
- In Fedora and Red Hat Enterprise Linux, ACLs are automatically enabled on any filesystem created when the system is installed.
- If you create a filesystem after installation (such as when you add a hard disk), you need to make sure that the `acl` mount option is used when the filesystem is mounted (more on that later).
- To add ACLs to a file, you use the `setfacl` command; to view ACLs set on a file, you use the `getfacl` command.
- To set ACLs on any file or directory, you must be the actual owner (user) assigned to it. In other words, being assigned user or group permissions with `setfacl` does not give you permission to change ACLs on those files yourself.
- Because multiple users and groups can be assigned to a file/directory, the actual permission a user has is based on a union of all user/group designations to which they belong. For example, if a file had read-only permission (`r--`) for the sales group and read/write/execute (`rwx`) for the market group, and mary belonged to both, mary would have `rwx` permission.

NOTE

If ACLs are not enabled on the filesystem you are trying to use with `setfacl`, see the section "Enabling ACLs" later in this chapter for information on how to mount a filesystem with ACLs enabled.

Setting ACLs with setfacl

Using the `setfacl` command, you can modify permissions (`-m`) or remove ACL permissions (`-x`). The following is an example of the syntax of the `setfacl` command:

```
setfacl -m u:username:rwx filename
```

In the example just shown, the modify option (`-m`) is followed by the letter `u`, indicating that you are setting ACL permissions for a user. After a colon (`:`), you indicate the username, followed by another colon and the permissions that you want to assign. As with the `chmod` command, you can assign read (`r`), write (`w`), and/or execute (`x`) permissions to the user or group (in the example, full `rwx` permission is given). The last argument is replaced by the actual filename you are modifying.

The following are some examples of the user mary using the setfacl command to add permission for other users and groups on a file:

```
[mary]$ touch /tmp/memo.txt
[mary]$ ls -l /tmp/memo.txt
-rw-rw-r--. 1 mary mary 0 Jan 21 09:27 /tmp/memo.txt
[mary]$ setfacl -m u:bill:rw /tmp/memo.txt
[mary]$ setfacl -m g:sales:rw /tmp/memo.txt
```

In the preceding example, mary created a file named /tmp/memo.txt. Using the setfacl command, she modified (-m) permissions for the user named bill so that he now has read/write (rw) permissions to that file. Then she modified permissions for the group sales so that anyone belonging to that group would also have read/write permissions. Look at ls -l and getfacl output on that file now:

```
[mary]$ ls -l /tmp/memo.txt
-rw-rw-r--+ 1 mary mary 0 Jan 21 09:27 /tmp/memo.txt
[mary]$ getfacl /tmp/memo.txt
# file: tmp/memo.txt
# owner: mary
# group: mary
user::rw-
user:bill:rw-
group::rw-
group:sales:rw-
mask::rw-
other::r--
```

From the ls -l output, notice the plus sign (+) in the rw-rw-r--+ output. The plus sign indicates that ACLs are set on the file, so you know to run the getfacl command to see how ACLs are set. The output shows mary as owner and group (same as what you see with ls -l), the regular user permissions (rw-), and permissions for ACL user bill (rw-). The same is true for group permissions and permissions for the group sales. Other permissions are r--.

The mask line (near the end of the previous getfacl example) requires some special discussion. As soon as you set ACLs on a file, the regular group permission on the file sets a mask of the maximum permission an ACL user or group can have on a file. So, even if you provide an individual with more ACL permissions than the group permissions allow, the individual's effective permissions do not exceed the group permissions as in the following example:

```
[mary]$ chmod 644 /tmp/memo.txt
[mary]$ getfacl /tmp/memo.txt
# file: tmp/memo.txt
# owner: mary
# group: mary
user::rw-
user:bill:rw-   #effective:r--
```

```
group::rw-      #effective:r--
group:sales:rw- #effective:r--
mask::r--
other::r--
```

Notice in the preceding example that even though the user `bill` and group `sales` have `rw-` permissions, their effective permissions are `r--`. So, `bill` or anyone in `sales` would not be able to change the file unless `mary` were to open permissions again (for example, by typing `chmod 664 /tmp/memo.txt`).

Setting default ACLs

Setting default ACLs on a directory enables your ACLs to be inherited. This means that when new files and directories are created in that directory, they are assigned the same ACLs. To set a user or group ACL permission as the default, you add a `d:` to the user or group designation. Consider the following example:

```
[mary]$ mkdir /tmp/mary
[mary]$ setfacl -m d:g:market:rwx /tmp/mary/
[mary]$ getfacl /tmp/mary/
# file: tmp/mary/
# owner: mary
# group: mary
user::rwx
group::rwx
other::r-x
default:user::rwx
default:group::rwx
default:group:sales:rwx
default:group:market:rwx
default:mask::rwx
default:other::r-x
```

To make sure that the default ACL worked, create a subdirectory. Then run getfacl again. You will see that default lines are added for user, group, mask, and other, which are inherited from the directory's ACLs:

```
[mary]$ mkdir /tmp/mary/test
[mary]$ getfacl /tmp/mary/test
# file: tmp/mary/test
# owner: mary
# group: mary
user::rwx
group::rwx
group:sales:rwx
group:market:rwx
mask::rwx
other::r-x
```

```
default:user::rwx
default:group::rwx
default:group:sales:rwx
default:group:market:rwx
default:mask::rwx
default:other::r-x
```

Notice that when you create a file in that directory, the inherited permissions are different. Because a regular file is created without execute permission, the effective permission is reduced to `rw-`:

```
[mary@cnegus ~]$ touch /tmp/mary/file.txt
[mary@cnegus ~]$ getfacl /tmp/mary/file.txt
# file: tmp/mary/file.txt
# owner: mary
# group: mary
user::rw-
group::rwx          #effective:rw-
group:sales:rwx     #effective:rw-
group:market:rwx    #effective:rw-
mask::rw-
other::r--
```

Enabling ACLs

In recent Fedora and RHEL systems, xfs and ext filesystem types (ext2, ext3, and ext4) are automatically created with ACL support. On other Linux systems, or on filesystems created on other Linux systems, you can add the `acl` mount option in several ways:

- Add the `acl` option to the fifth field in the line in the `/etc/fstab` file that automatically mounts the filesystem when the system boots up.
- Implant the `acl` line in the `Default mount options` field in the filesystem's super block, so that the `acl` option is used whether the filesystem is mounted automatically or manually.
- Add the `acl` option to the `mount` command line when you mount the filesystem manually with the `mount` command.

Keep in mind that in Fedora and Red Hat Enterprise Linux systems, you only have to add the `acl` mount option to those filesystems that were created elsewhere. The anaconda installer automatically adds ACL support to every filesystem it creates during install time and `mkfs` adds `acl` to every filesystem you create with that tool. To check that the `acl` option has been added to an ext filesystem, determine the device name associated with the filesystem, and run the `tune2fs -l` command to view the implanted mount options, as in this example:

```
# mount | grep home
/dev/mapper/mybox-home on /home type ext4 (rw)
# tune2fs -l /dev/mapper/mybox-home | grep "mount options"
Default mount options:    user_xattr acl
```

First, I typed the `mount` command to see a list of all filesystems that are currently mounted, limiting the output by grepping for the word `home` (because I was looking for the filesystem mounted on `/home`). After I saw the filesystem's device name, I used it as an option to `tune2fs -l` to find the default mount options line. There, I could see that mount options `user _ xattr` (for extended attributes such as SELinux) and `acl` were both implanted in the filesystem super block so that they would be used when the filesystem was mounted.

If the `Default mount options` field is blank (such as when you have just created a new filesystem), you can add the `acl` mount option using the `tune2fs -o` command. For example, on a different Linux system, I created a filesystem on a removable USB drive that was assigned as the `/dev/sdc1` device. To implant the `acl` mount option and check that it is there, I ran the following commands:

```
# tune2fs -o acl /dev/sdc1
# tune2fs -l /dev/sdc1 | grep "mount options"
Default mount options:    acl
```

You can test that this worked by remounting the filesystem and trying to use the `setfacl` command on a file in that filesystem.

A second way to add `acl` support to a filesystem is to add the `acl` option to the line in the `/etc/fstab` file that automatically mounts the filesystem at boot time. The following is an example of what a line would look like that mounts the ext4 filesystem located on the `/dev/sdc1` device to the `/var/stuff` directory:

```
/dev/sdc1      /var/stuff       ext4    acl         1 2
```

Instead of the `defaults` entry in the fourth field, I added `acl`. If there were already options set in that field, add a comma after the last option and add `acl`. The next time the filesystem is mounted, ACLs are enabled. If the filesystem were already mounted, I could type the following `mount` command as root to remount the filesystem using `acl` or any other values added to the `/etc/fstab` file:

```
# mount -o remount /dev/sdc1
```

A third way that you can add ACL support to a filesystem is to mount the filesystem by hand and specifically request the `acl` mount option. So, if there were no entry for the filesystem in the `/etc/fstab` file, after creating the mount point (`/var/stuff`), type the following command to mount the filesystem and include ACL support:

```
# mount -o acl /dev/sdc1 /var/stuff
```

Keep in mind that the `mount` command only mounts the filesystem temporarily. When the system reboots, the filesystem is not mounted again, unless you add an entry to the `/etc/fstab` file.

Adding directories for users to collaborate

A special set of three permission bits are typically ignored when you use the `chmod` command to change permissions on the filesystem. These bits can set special permissions on commands and directories. The focus of this section is setting the bits that help you create directories to use for collaboration.

As with read, write, and execute bits for `user`, `group`, and `other`, these special file permission bits can be set with the `chmod` command. If, for example, you run `chmod 775 /mnt/xyz`, the implied permission is actually `0775`. To change permissions, you can replace the number 0 with any combination of those three bits (4, 2, and 1), or you can use letter values instead. (Refer to Chapter 4, "Moving Around the Filesystem," if you need to be reminded about how permissions work.) The letters and numbers are shown in Table 11.1.

TABLE 11.1 Commands to Create and Use Files

Name	Numeric value	Letter value
Set user ID bit	4	u+s
Set group ID bit	2	g+s
Sticky bit	1	o+t

The bits in which you are interested for creating collaborative directories are the set group ID bit (2) and sticky bit (1). If you are interested in other uses of the set user ID and set group ID bits, refer to the sidebar "Using Set UID and Set GID Bit Commands."

Creating group collaboration directories (set GID bit)

When you create a set GID directory, any files created in that directory are assigned to the group assigned to the directory itself. The idea is to have a directory where all members of a group can share files but still protect them from other users. Here's a set of steps for creating a collaborative directory for all users in the group I created called `sales`:

1. Create a group to use for collaboration:

   ```
   # groupadd -g 301 sales
   ```

2. Add to the group some users with which you want to be able to share files (I used `mary`):

   ```
   # usermod -aG sales mary
   ```

3. Create the collaborative directory:

   ```
   # mkdir /mnt/salestools
   ```

Using Set UID and Set GID Bit Commands

The set UID and set GID bits are used on special executable files that allow commands set to be run differently than most. Normally, when a user runs a command, that command runs with that user's permissions. In other words, if I run the `vi` command as `chris`, that instance of the `vi` command would have the permissions to read and write files that the user `chris` could read and write.

Commands with the set UID or set GID bits set are different. It is the owner and group assigned to the command, respectively, that determines the permissions the command has to access resources on the computer. So, a set UID command owned by root would run with root permissions; a set GID command owned by apache would have apache group permissions.

Examples of applications that have set UID bits turned on are the `su` and `newgrp` commands. In both of those cases, the commands must be able to act as the root user to do their jobs. However, to actually get root permissions, a user must provide a password. You can tell `su` is a set UID bit command because of the `s` where the first execute bit (`x`) usually goes:

```
$ ls /bin/su
-rwsr-xr-x. 1 root root  30092 Jan 30 07:11 su
```

4. Assign the group `sales` to the directory:

```
# chgrp sales /mnt/salestools
```

5. Change the directory permission to 2775. This turns on the set group ID bit (2), full `rwx` for the `user` (7), `rwx` for `group` (7), and `r-x` (5) for `other`:

```
# chmod 2775 /mnt/salestools
```

6. Become `mary` (run `su - mary`). As `mary`, create a file in the shared directory and look at the permissions. When you list permissions, you can see that the directory is a set GID directory because a lowercase `s` appears where the group execute permission should be (`rwxrw`**`s`**`r-x`):

```
# su - mary
[mary]$ touch /mnt/salestools/test.txt
[mary]$ ls -ld /mnt/salestools/ /mnt/salestools/test.txt
drwxrwsr-x. 2 root sales 4096 Jan 22 14:32 /mnt/salestools/
-rw-rw-r--. 1 mary sales    0 Jan 22 14:32 /mnt/salestools/test.txt
```

Typically, a file created by `mary` would have the group `mary` assigned to it. But because `test.txt` was created in a set group ID bit directory, the file is assigned to the `sales` group. Now, anyone who belongs to the `sales` group can read from or write to that file, based on group permissions.

Creating restricted deletion directories (sticky bit)

A *restricted deletion directory* is created by turning on a directory's sticky bit. What makes a restricted deletion directory different than other directories? Normally, if write permission

is open to a user on a file or directory, that user can delete that file or directory. However, in a restricted deletion directory, unless you are the root user or the owner of the directory, you can never delete another user's files.

Typically, a restricted deletion directory is used as a place where lots of different users can create files. For example, the `/tmp` directory is a restricted deletion directory:

```
$ ls -ld /tmp
drwxrwxrwt. 116 root root 36864 Jan 22 14:18 /tmp
```

You can see that the permissions are wide open, but instead of an `x` for the execute bit for `other`, the `t` indicates that the sticky bit is set. The following is an example of creating a restricted deletion directory with a file that is wide open for writing by anyone:

```
[mary]$ mkdir /tmp/mystuff
[mary]$ chmod 1777 /tmp/mystuff
[mary]$ cp /etc/services /tmp/mystuff/
[mary]$ chmod 666 /tmp/mystuff/services
[mary]$ ls -ld /tmp/mystuff /tmp/mystuff/services
drwxrwxrwt. 2 mary mary   4096 Jan 22 15:28 /tmp/mystuff/
-rw-rw-rw-. 1 mary mary 640999 Jan 22 15:28 /tmp/mystuff/services
```

With permissions set to `1777` on the `/tmp/mystuff` directory, you can see that all permissions are wide open, but a `t` appears instead of the last execute bit. With the `/tmp/mystuff/services` file open for writing, any user could open it and change its contents. However, because the file is in a sticky bit directory, only root and `mary` can delete that file.

Centralizing User Accounts

Although the default way of authenticating users in Linux is to check user information against the `/etc/passwd` file and passwords from the `/etc/shadow` file, you can authenticate in other ways as well. In most large enterprises, user account information is stored in a centralized authentication server, so each time you install a new Linux system, instead of adding user accounts to that system, you have the Linux system query the authentication server when someone tries to log in.

As with local `passwd/shadow` authentication, configuring centralized authentication requires that you provide two types of information: account information (username, user/group IDs, home directory, default shell, and so on) and authentication method (different types of encrypted passwords, smart cards, retinal scans, and so on). Linux provides ways of configuring those types of information.

Authentication domains that are supported via the `authconfig` command include LDAP, NIS, and Windows Active Directory.

Supported centralized database types include the following:

LDAP The *Lightweight Directory Access Protocol (LDAP)* is a popular protocol for providing directory services (such as phone books, addresses, and user accounts). It is an open standard that is configured in many types of computing environments.

NIS The *Network Information Service (NIS)* was originally created by Sun Microsystems to propagate information such as user accounts, host configuration, and other types of system information across many UNIX systems. Because NIS passes information in clear text, most enterprises now use the more secure LDAP or Winbind protocols for centralized authentication.

Winbind Selecting *Winbind* from the Authentication Configuration window enables you to authenticate your users against a Microsoft Active Directory (AD) server. Many large companies extend their desktop authentication setup to do server configuration as well as using an AD server.

If you are looking into setting up your own centralized authentication services and you want to use an open-source project, I recommend looking into the 389 Directory Server (`https://directory.fedoraproject.org/`). Fedora and other Linux systems offer this enterprise-quality LDAP server.

Summary

Having separate user accounts is the primary method of setting secure boundaries between the people who use your Linux system. Regular users typically can control the files and directories within their own home directories but very little outside of those directories.

In this chapter, you learned how to add user and group accounts, how to modify them, and even how to extend user and group accounts beyond the boundaries of the local `/etc/passwd` file. You also learned that authentication can be done by accessing centralized LDAP servers.

The next chapter introduces another basic topic needed by Linux system administrators: how to manage disks. In that chapter, you learn how to partition disks, add filesystems, and mount them so the contents of the disk partitions are accessible to those using your system.

Exercises

Use these exercises to test your knowledge of adding and managing user and group accounts in Linux. These tasks assume that you are running a Fedora or Red Hat Enterprise Linux system (although some tasks work on other Linux systems as well). If you are stuck, solutions to the tasks are shown in Appendix B (although in Linux, you often have multiple ways to complete a task).

1. Add a local user account to your Linux system that has a username of `jbaxter` and a full name of John Baxter and that uses `/bin/sh` as its default shell. Let the UID be assigned by default. Set the password for `jbaxter` to: `My1N1te0ut!`
2. Create a group account named `testing` that uses group ID 315.
3. Add `jbaxter` to the `testing` group and the bin group.
4. Open a shell as `jbaxter` (either a new login session or using a current shell) and temporarily have the `testing` group be your default group so that when you type `touch /home/jbaxter/file.txt`, the `testing` group is assigned as the file's group.
5. Note what user ID has been assigned to `jbaxter`, and delete the user account without deleting the home directory assigned to `jbaxter`.
6. Find any files in the `/home` directory (and any subdirectories) that are assigned to the user ID that recently belonged to the user named `jbaxter`.
7. Copy the `/etc/services` file to the default skeleton directory so that it shows up in the home directory of any new user. Then add a new user to the system named `mjones`, with a full name of Mary Jones and a home directory of `/home/maryjones`.
8. Find all files under the `/home` directory that belong to `mjones`. Are there any files owned by `mjones` that you didn't expect to see?
9. Log in as `mjones`, and create a file called `/tmp/maryfile.txt`. Using ACLs, assign the `bin` user read/write permission to that file. Then assign the `lp` group read/write permission to that file.
10. Still as `mjones`, create a directory named `/tmp/mydir`. Using ACLs, assign default permissions to that directory so that the `adm` user has read/write/execute permission to that directory and any files or directories created in it. Create the `/tmp/mydir/testing/` directory and `/tmp/mydir/newfile.txt` file, and make sure that the `adm` user was also assigned full read/write/execute permissions. (Note that despite `rwx` permission being assigned to the `adm` user, the effective permission on `newfile.txt` is only `rw`. What could you do to make sure that `adm` gets execute permission as well?)